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6 May 1981

Worldwide Report

ENVIRONMENTAL QUALITY

(FOUO 3/81)

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CONTENTS

CUBA

PLANS TO CLEAN UP HAVANA BAY DISCUSSED

Havana BOHEMIA in Spanish 20 Feb 81 p 32

[Article by Gregorio Hernandez]

[Text] The news read as follows: "Havana (AIN) 25 November--A minor fire broke out yesterday morning on one side of Havana Bay, burning oil that had accumulated on the water. No human or material damage resulted."

This incident, which fortunately had no major consequences, brings up a matter of cardinal importance: the problem of the contamination or pollution of Havana City Bay.

In going into the issue more deeply, we should point out that among the main causes or pollutants of Havana Bay waters are oil spills, the dumping of industrial waste and sewage from the city and the uncontrolled disposal of toxic and other substances into the ocean.

What will the effect of this be? Serious damage will be done to living resources, there will be a great risk to human health, and marine activities, including fishing, will be affected. The useful life of concrete, steel and other type facilities at the port will be shortened.

The problem of the pollution of Havana Bay is not a new one. Concern began to be manifested as early as a century ago. In 1886, a proposal was worked out and published in New York that same year under the title "Study of Sanitation to Protect the Port of Havana." The learned Carlos J. Finlay participated in the project. In the early decades of this century, scientists expressed their concern over this serious situation, but as one might suppose, nothing much was done.

Naturally, a brand-new minister of public works in the Batista regime made a bombastic announcement in 1955 of a project for the improvement, modernization, sanitation, dredging and so on, of Havana Bay, including the construction of a canal connecting with the Cojimar River, which would be completely dredged and channeled for the entry and exit of small boats, leaving the main canal for larger vessels. It was later shown that this "project" was nothing more than a screen to hide fraudulent dealings, for no plans or descriptions or anything of the sort were ever found and a project of this scope could not have gone unnoticed.

At the present time, the Almendares River and Havana Bay continue to be veritable centers of pollution, especially the Bay, since it is the destination for sewage pipes and stre[illegible] carrying all kinds of pollutants. The Bay itself has shipyards, dikes and many boats that produce uncontrolled pollution.

In our investigation into possible solutions, we learned that a project is already being carried out based on international experience. Since 1979, different national institutions have intensified research into the pollution of Havana Bay.

Last year, 1980, a project called Cuba/80/001 was approved, sponsored by the United Nations and financed by specialized UNDP and PNUMA [expansion unknown] organizations. The executive agency will be UNESCO, which administers outside financing.

Within this framework, the main task of Cuba will belong to the Ministry of Transport, which has designated the Center for Port Development as the executive government agency. The project involves more than 11 institutions in the country and the grant from UN international agencies exceeds 1 million pesos. At the same time, the Cuban Government will invest counterpart funds exceeding that figure.

This is a project delving deeply into the causes and consequences of the pollution of Havana Bay and it is part of a special government program, 041 Havana Bay Pollution, approved by the country's scientific and technical institutions for this 5-year period. Its goal is to begin solving the problem.

In conclusion, we can say that this information answers the question contained in the title of this article ["Will the Pollution of Havana Bay Be Eradicated?"].

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METHODS, MEANS OF CONTROLLING AIR POLLUTION

Kiev METODY I SREDSTVA KONTROLYA ZAGRYAZNENIYA ATMOSFERY in Russian 1980 (signed to press 12 Jun 80) pp 1-2, 5-13, 293-296

[Annotation, introduction and table of contents from book "Methods and Means of Controlling Air Pollution", by Al'fred Viktorovich Primak and Aleksandr Nazarovich Shcherban', Naukova dumka, 2000 copies, 296 pages]

[Text] The monograph covers questions of automating control of air quality in production rooms, administrative and public buildings and structures, the air basin of enterprises, industrial complexes and cities. It makes a systems analysis of technical, hygienic and economic aspects. It substantiates the strategy for automating monitoring and controlling and means for realizing it. It formulates criteria for selecting and optimizing the goals, structures, individual components and characteristics of the hierarchical tree of different subsystems. It presents the results of development and experimental-industrial approval of a set of plant, municipal, cluster and regional technical equipment of experimental automated systems of collecting and processing information on atmospheric pollution.

It is designed for specialists who are solving problems of protection from environmental pollution.

Ninety illustrations, 24 tables, 416 bibliographic entries (pp 276-292).

Introduction

The second half of the 20th century has been a period of drastic increase in man's technical might, the scales of his activity. This has exceptionally aggravated the problem of interrelationships between nature and society, and has turned it into the most urgent problem of the present time. Atmospheric pollution hides a great danger for the biosphere: a normally functioning body needs 12 kg of air per day, and clean air, without admixtures that are harmful for health. At the same time, the intensive growth of modern industry, power engineering and transportation promotes a sharp increase in the quantity of adverse substances that are discharged into the atmosphere of production rooms and the lower air layers of cities and industrial complexes.

One can generally isolate five main sources of air pollution (AP): combustion of sulfur-containing fuel; release of exhausts of automotive transportation; emissions of industrial enterprises; radiation; and the use of pesticides and insecticides.

Without diminishing the threat of radioactive pollution of the atmosphere (products of nuclear explosions, radioactive wastes of the nuclear industry enterprises) and the recently realized, but extremely serious threat of pollution of organochloride pesticides and synthetic insecticides that are not biodegradable, one should admit that the first three types of air pollution are the most dangerous because of their mass nature and potential growth.

As the statistics indicated, roughly 80% of all types of AP are a result of energy processes, extraction, processing and use of energy resources. Over 90% of the world demand for primary energy is currently satisfied by the use of oil, coal and gas. The percentage of atomic energy in the energy balance is 1.5%, although it has a great outlook. Throughout the world, about 2 billion tons of different coals are burned annually. Roughly 2.2 billion tons of oil, 2 billion tons of ore and nonmetalliferous materials are extracted and refined. This results in a discharge into the atmosphere of 220 million tons of sulfurous anhydride, 450 million tons of carbon monoxide, 75 million tons of nitric oxides and 150 million tons of different aerosols.

About 80% of the world's electricity comes from the heat and electric power stations (TETs). Their efficiency is currently no greater than 40-42%. The flue gases of the boiler units during coal combustion contain solid particles (dust, ash, carbon), oxides of sulfur and nitrogen, carbon monoxide, and during gas combustion they contain nitric oxides, carbon monoxide, hydrocarbons and aldehydes. The quantity of discharged ingredients is determined to a considerable measure by the type of fuel used. In the region of a TETs with output of over 1 million kW the pollutants spread 10-15 km. TETs emissions mainly consist of ash and sulfuric oxides (99-98% SO_2 and 1-2% SO_3). Combining with water vapors in the atmosphere, sulfur trioxide gives rise to sulfuric acid whose suspensions are extremely dangerous. Metal suspensions in the air have a catalytic effect on SO_2 oxidation and its conversion into SO_3: iron, zinc, manganese, etc. Release of sulfur compounds in the area of metallurgical plants is therefore especially dangerous. Atmospheric pollution with sulfur compounds, aggravated by migrations of the latter great distances, has ceased to be a local phenomenon and covers enormous territories. By having a synergic effect with the dust content, it is the main type not only of thermal energy, but also industrial pollution as a whole in the majority of countries. At the current stage of technological development, an economically effective method for purifying the combustion products of sulfur compounds has not yet been developed. It is only possible to purify the fuel itself of sulfur and collect it. There are no obstacles to purifying gaseous fuels of sulfur. Sulfur purification of liquid fuel is technically feasible, but not always economically profitable. It is more complicated to remove sulfur from solid fuel. Carbon monoxide is not an inevitable component of fuel combustion products. The correct design of the equipment and the correct care of it will avoid CO formation in the burners. However, the high combustion temperatures of the burners that are useful from the viewpoint of their efficiency, cause intensive formation of nitric oxides. The danger of poisoning by them, as studies show, is much higher than the danger of poisoning by equivalent concentrations of CO and SO_2. Moreover nitric oxides play a decisive role in the formation of photochemical smog. The toxic effect of the latter is proportional to the product of concentrations of nitric oxides and hydrocarbons in the air. In addition to the examined ingredients, the TETs emissions contain dangerous oxides of heavy metals, particles of carcinogenic resins and dust. The latter, even in a small concentration, intensifies the effect of other harmful ingredients.

The emissions of carbon dioxide that accompany fuel combustion hide a great danger for mankind. About half of it is dissolved in the ocean and is absorbed by living organisms. The other half remains in the atmosphere, promoting the development of the so-called greenhouse effect, an increase in the average atmospheric temperature.

The carbon dioxide concentration in the atmosphere recently increased by roughly 0.2% per year. This affects only the microclimate of large cities where "heat islands" develop. However fuel combustion is rapidly rising and the production of energy rises at a rate of 6% per year. With such growth rates, heat of artificial origin in the next century may be comparable to the energy the earth receives from the sun. By the year 2000, the average planetary temperature can increase as compared to 1970 by 0.5 degrees, and in the upper latitudes, by roughly 1 degree. Sharp warming of the planet will cause the Greenland and Antarctic glaciers to melt. This will lead to a significant rise in the level of the World Ocean. Large spaces of land with large population and industrial concentration will be flooded, or will have to expend enormous efforts and resources to protect them. The change in the moisture turnover on the continents will create great difficulties for agriculture and other sectors.

Currently, despite the intensive search for new technical solutions and methods of running the burners that would permit the discharges of oxides of nitrogen and sulfur to be reduced to a minimum with simultaneous high energy efficiency, the chief measure of protecting the atmosphere from TETs emissions is dispersion of the latter in the smokestacks 180-320 m high. The cost is roughly 10 times lower than the cost of the treatment works. The total quantity of emissions is not reduced however. The trend, noted in England in particular, towards redistribution of different types of fuel reduced the quantity of solid fraction emissions by 50%, but the quantity of SO_2 entering the air rose by 56%. An analogous situation is also characteristic for other countries. As is apparent, the extant technology and purification methods do not rid the air basin of TETs emission pollution.

The intensive development of automobile transportation, increase in the machine fleet and growth in engine power inevitably result in an increase in the percentage of exhausts in the air. The world automobile fleet, exceeding 300 million cars, annually emits over 240 million tons of carbon monoxide, 12 million tons of nitric oxides and 66 million tons of different hydrocarbons. The solution to the problem of purifying and reducing the harmfulness of automobile engine exhaust is linked to improving the process of fuel combustion by adding compressed gas or complete conversion of the internal combustion engines to gaseous fuel, intensification of the combustion process using special design and technological measures, catalytic afterburning of the combustion products, and purification of the exhaust gases by liquid filters. A basic solution might be the creation of electric cars that are capable of competing with different car models. The latter is impaired by the lack of compact, efficient storage batteries. Now the content of carbon monoxide on the streets of a number of cities with intensive traffic reaches 40-60 maximum permissible concentrations (MPC) in individual periods. If effective measures are not taken to reduce the automobile emissions, the CO concentrations will rise more than 5-fold by 1990.

One of the principal problems is industrial pollution of the air basin. Because of the rise in the number of enterprises, the construction of powerful industrial complexes and increase in labor productivity, the problem of preventing air pollution with industrial emissions is becoming more acute. The modern ferrous

metallurgical complexes that include metallurgical plants with by-product coke plants and agglomeration factories, metal-working and machine construction plants, enterprises to produce cement, slag blocks, plastics, agricultural fertilizers, etc., are a source of intense air pollution with dust (containing roughly 30% of free silicon dioxide), sulfur dioxide, carbon monoxide, nitric oxides, hydrogen sulfide, phenols, carcinogenic hydrocarbons (benzpyrene), methanol, carbon black, arsenic, ferric oxides and other toxic compounds in a radius of 10-15 km and more. The nonferrous metallurgical enterprises pollute the air with dust, carbon monoxide, oxides of nitrogen and sulfur. The plants of the copper and lead-zinc industry discharge into the atmosphere, in addition, a considerable quantity of carbon disulfide and lead. The plants of the aluminum industry emit hydrogen fluoride and resinous distillates. The enterprises of the magnesium and rare metal industry discharge hydrogen chloride, etc. A high concentration of carbon monoxide, oxides of sulfur and nitrogen, phenols, dust, lead and hydrocarbons is observed in the regions of machine construction enterprises. The enterprises of the construction industry, especially the asphalt-cement plants, are a source of strong air pollution with dust, carbon monoxide, phenols, carbon black, carbon disulfide, formaldehyde and hydrocarbons. The chemical plants, enterprises of nitrogen and basic chemistry, synthetic chemistry, and artificial fiber plants are powerful sources of air pollution with nitric oxides, carbon dioxide, ammonia gas, sulfurous anhydride, methanol,formaldehyde, carbon disulfide, hydrogen sulfide, hydrogen cyanide, fluorine, arsenic, benzene, ethylbenzene, styrene, mercury and other highly toxic ingredients in a radius up to 10 km from the emission sources. The pulp and paper enterprises pollute the air of the surrounding territories with carbon disulfide, carbon monoxide, nitrogen dioxide, and hydrogen sulfide. The petrochemical and oil refineries create a zone of increased concentration of hydrocarbons, hydrogen sulfides, nitric oxides, phenols, carbon monoxide and sulfuric gas. The emissions of the carbon black plants, besides carbon black (dispersed carbon), contain considerable concentrations of carbon monoxide, nitric oxides, hydrogen sulfide, resinous organic compounds with carcinogenic properties. The mining enterprises and the coal mines pollute the air with sulfuric gas, nitric oxides, hydrogen sulfide, carbon monoxide and dust. A no less, if not more serious problem here continues to be the creation and maintenance of the normal state of the production atmosphere (PA). The exposure of the latter to continual heat and moisture, toxic and dangerously explosive disorders is responsible for the comparatively high injury level. The successful resolution of the problem of creating safe and healthy working conditions at the enterprises is important not only from the viewpoint of today, but also for the future development of the majority of industrial sectors that are inseparably linked to the creation of efficient systems for automatic control, regulation and protection of the PA. All the extant systems of controlling and regulating the PA both in our country and abroad have been formulated without a link to the medical-biological and socio-economic aspects of industrial ecology. The interrelationship between various occupational and production hazards with regard for their combined effect has not been considered. All of this has promoted a rise not only in the total level of air pollution of the industrial rooms, but also the air basin as a whole to a considerable measure.

Each year the number of varieties and concentration of toxic ingredients in the atmosphere increase. Their total quantity increases roughly in proportion to the growth of products, despite the measures taken to purify the emissions. In 25 years, the air pollution in the majority of large cities and industrial complexes has risen 4-4.5-fold. In the Soviet Union, thanks to the planned facilities and

all possible concern by the party and government for the welfare of the workers, the environmental pollution level, including the air basin, is considerably lower than in the developed capitalist countries (table 1) [4]. It is apparent from table 1 that with roughly the same volume of output of industrial products in the USSR and the United States, the share of the United States in world environmental pollution is triple the corresponding indicator for the USSR.

According to 1968 sanitary statistics, the United States discharged into the atmosphere 142 million tons of toxic substances [5], of which 32 million tons were sulfuric gas discharged by the power plants and local heating systems, 85 million tons were automobile exhausts, including 66 million tons of carbon monoxide, 6 million tons of nitric oxides, 0.19 million tons of lead derivatives, 12 million tons of hydrocarbons and 1 million tons of sulfuric oxides, and 25 million tons were emissions of industrial enterprises [62]. In 1973, the total discharges in the United States exceeded 200 million tons. By the year 2000, the discharges of carbon monoxide alone will be 181 million tons, nitric oxides 40.6 million tons, sulfur dioxide 49.5 million tons, etc. The share of the United States in air pollution by all the capitalist and developing countries of the world in 1970 was: SO_x--29.8%, CO--59.5%, NO_x--42%, CH--57.5%, suspended particles--26.2%. The share of the largest capitalist countries of Europe (Belgium, England, Denmark, Italy, Netherlands, France, the FRG and Sweden) was respectively: for SO_x--41%, CO--17.6%, NO_x--31%, CH--18%, for suspended particles--35%. Among them the greatest contributors to AP were the FRG, Great Britain, and France. In the FRG, for example, in 1970 8.183 million tons of SO_x, 4.681 million tons of CO, 2.352 million tons of NO_x, 624,000 tons of hydrocarbons and 1.53 million tons of dust were discharged into the air. The share of Japan in AP by the capitalist countries of Asia is 56.7% for SO_2, 47% for CO, 55.2% for NO_x, 49.5% for CH and 59.2% for dust. For specific density of industrial emission distribution, the worst situation is in the FRG, 33 T/km^2. This is 20 plus times more than in the United States, and 2.9-fold more than in Japan. In Belgium this quantity is 27.4 T/km^2 and in England it is 18.3 T/km^2. The annual rise in AP in such countries as the FRG, Japan and the United States is 11.5-15% [259]. The problem of controlling AP has therefore been advanced among the principal problems. It is causing serious concern among the governments, world public opinion,and scientists and engineers.

Protection of the air basin from industrial pollution, prevention of discharges into the atmosphere of enterprises of the ferrous and nonferrous metal industries, cement, chemical and oil industries, coke production and others are inseparably linked to the development of new forms of complex production with a closed technological cycle that guarantees the maximum recovery of wastes. In the majority of cases, this is quite feasible if the task is set at the stage of developing the process and planning production. It is much less expensive and simpler to provide for the creation of technology without emissions than to build treatment works that are often more expensive than the main industry. But all of this is a matter for the future. Now AP has a fatal effect on human health, It causes increased sickness and consequently, losses of working time and decrease in the production rates. It diminishes the agricultural crop harvest and leads to a loss of their nutritional value. It accelerates corrosion of machines and equipment, etc. Clinical and epidemiological studies indicate the direct relationship between air pollution, sickness and the death rate among the population. Without dwelling on the mechanism for the effect of pollutants during direct contact with the human body, one can note that smoke smog is the cause of injury to the respiratory

Table 1. Share of Main Groups of Countries in World Industrial Production (1971)

Countries	Population, % of world population	Industrial production, %	Average annual increase in products, % for 1951-1971	Share in world pollution of environment,%
Socialist	33	39	9.0	24
Including USSR	6.6	20	10.0	10
Developed capitalist	19.5	53	5.1	63
Including United States	5.5	24.6	4.1	31
Western Europe	8	19.2	5.4	20
Japan	3	5.6	6.8	6
Developing	47.5	8	7.0	13

organs (pulmonary emphysema, bronchitis, asthma). Photochemical smog irritates the mucous membranes of the eyes and nasopharynx. Nitric oxides that are easily absorbed by the blood have a harmful effect on the lungs and eyes. Carbon (soot), by adsorbing carcinogenic substances, is a source of lung cancer. Phenol results in complex disorders of metabolism in the body. Sulfurous anhydride at low concentrations causes chronic bronchitis, and in considerable concentrations induces fatal pulmonary edema. Carbon monoxide and hydrogen sulfide in increased concentrations are fatal. Irritation of the lungs by any harmful agent increases the rate of absorption of other potentially harmful agents into the blood. Aerosols dissolved in the blood are carried to other vital organs, aggravating the general injury to the body. Aerosols of beryllium and its compounds are extremely dangerous even in small concentrations. They induce chronic sickness of the lungs (granulomatosis, belliosis). Manganese and its compounds cause pneumonia. Radioactive isotopes affect the human tissues and organs (anemia, leukemia, hemorrhagic syndrome, bone neurosis, decrease in activity of the thyroid gland, disrupted activity of the sex glands, congenital disorders, affection of the lungs, fibrosis, sarcoma, cancer, etc.). Carcinogenic agents cause cancer. Mercury has a fatal effect on the human brain. The cumulative effect is very dangerous. This is the possible accumulation in the human body of toxins whose effect does not appear until a certain time, but nevertheless, causes its slow poisoning and contributes to genetic changes in the heredity carriers and the development of diseases whose consequences are manifest in many years.

According to the World Health Organization (WHO), in the last 50 years, the number of lung cancer victims has increased greatly in many countries. In England, for example, the number of victims increased 40-fold. In the cities, the number of these victims among nonsmokers is double, and among the smokers 10-fold greater than in the countryside. According to estimates of the American ecologist Commoner, those who breathe New York air are exposed to lung cancer almost to the same degree as the people who smoke two packs of cigarettes a day. The death rate from pulmonary emphysema in the United States rose since 1950 by more than 10-fold. It has been established that the quantity of lead in the blood of the urban population in the United States is 30-40% greater than the rural. According to an examination made in the industrial regions of Ostrava (Czechoslovakia), the number of conjunctivitis victims increased 5-20-fold, while the duration of treatment of this disease is double as compared to the other less polluted regions of the country.

The total economic damage from AP, including damage from its direct or indirect effect on human health, the fauna and flora, losses from corrosion of different materials and expenditures for protective coatings for them, to maintain the external and internal condition of housing and other structures in the proper state, losses from depreciating facilities and commodities exposed to the effect of AP, direct losses from emission of products of incomplete fuel combustion in boilers, machines and units, indirect losses associated with different technical improvements to control smoke and other industrial emissions, rise in price of electricity because of the purification of TETs exhausts, etc. already reaches billions of dollars per year in the industrially developed countries. In the United States in 1968, the damage from AP to the health of the population was estimated as 8.1 billion dollars, 5.2 billion dollars to residential construction, and 4.9 billion dollars to vegetation. In 1977 this damage was respectively 9.3, 8 and 7.6 billion dollars. The average annual damage for the developed countries is from 10 to 100 dollars per person. If one assumes that the extant trends will be maintained in the future, in 25-30 years mankind will be faced with an ecological catastrophe.

Mankind possesses sufficient knowledge and potentialities to eliminate the unfavorable consequences of its activity and to restore equilibrium in the environment so that it corresponds to its modern needs and provides for the needs of future generations. Our socialist society has the best potentialities for this. The Communist Party and the Soviet government view the problem of environmental protection as an inseparable part of the state policy. It would be erroneous to believe, however, that in our planned economy there are no difficulties in resolving contradictions in the relations of man and nature and that there are fewer unresolved problems than resolved ones. This is why development of the scientific fundamentals for protecting the air basin was classified by the program document of the 25th CPSU Congress "Main Directions for the Development of the USSR National Economy for 1976-1980" among the most important directions in the development of scientific research in the 10th Five-Year Plan.

The relationships between the economy and ecology are complicated. Giving the proper perspective to the future creation of waste-free enterprises with complex use of raw materials, it is impossible not to admit that it is not always and not everywhere possible to change the technology of production and introduce new highly efficient treatment works at the active enterprises today for economic considerations. There is only one outlet under these conditions, to find the optimal correlation of economic and ecological indicators that guarantee a rise in social production with strict restriction of the ecological imbalance. Highly developed social production and a systematic development of it, in addition to the constant concern of our socialist state about the welfare of all members of society will permit organization of control over the growth of the economy with regard for the requirements of ecology, and creation of a centralized system of environmental protection that is unified for the entire country. The combination of the advantages of socialism with the achievements of scientific and technical progress will provide the developed socialist society with powerful resources for a purposeful effect on nature, guaranteeing the prevention of the most harmful threat of an ecological crisis. The new principles and methods of air quality control in the major cities and industrial complexes must become an inseparable part of the unified environmental protection system. The most harmonious combination of economics and ecology can be attained, in our opinion, by broad introduction of automated systems of monitoring AP (ASM AP) and of controlling the intensity of air pollution (ASC IAP).

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ECONOMICS OF CLEAN AIR

Kiev EKONOMIKA CHISTOGO VOZDUKHA in Russian 1979 (signed to press 22 May 79) pp 3-8, 294-296

[Annotation, introduction, and table of contents from book "Economics of Clean Air", by Oleg Fedorovich Balatskiy, Ukrainian SSR Academy of Sciences Institute of Technical Thermophysics, Izdatel'stvo "Naukova dumka", 1,900 copies, 296 pages]

[Text] This monograph is the first systems analysis, in domestic literature, of the economics of protecting against air pollution. The economic harm done by toxic exhausts into the atmosphere in industrially developed capitalist countries is studied. The procedures for determining total and specific losses are presented. A procedure for determining the economic effectiveness of the atmosphere's rehabilitation is suggested. Concrete computations are used to demonstrate application of the procedures for determining the losses, and the economic effectiveness of protecting the atmosphere against pollution. The theoretical fundamentals of environmental quality control are examined.

This monograph is intended for industrial engineers, technicians, economists, biologists, scientific research institute specialists, and VUZ and tekhnikum students.

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Introduction

The 20th century is characterized by fast development of industry and transportation, and swift growth of cities. The scope, magnitude, and depth of man's interference in the order of nature have grown significantly in this century. At the same time, man is just beginning in his attempts to control and plan processes occurring on a global scale.

As economic power develops and mankind's material blessings increase in number, so also grow the side-effects of progress--for example weapons of mass destruction, pollution of the surrounding and natural environment, and insufficiently economical use of land, oceans and seas, fresh water, and natural resources. Environmental pollution has been raising especially great concern among the populations of all countries in recent years. Engels wrote the following about this back in the last century: "We must not, however, boast too much about our victories over nature. For each such victory, it takes its revenge upon us. At first, each of these victories does of course produce the consequences which we intended, but later on they also produce entirely different, unforeseen consequences, which very often annihilate the significance of the first" ((1), pages 495-496).

However, man, who is to blame for the negative results, possesses or will possess the knowledge and potentials necessary to prevent unfavorable consequences. Mankind's development and the welfare of present and future generations depend upon timely solution of these problems (125, 132).

Environmental problems agitate all developed and developing countries. But the acuity of these problems varies in different countries and within each country in view of different factors, among which social and economic factors play a significant role. Economic development of capitalist countries, together with its associated irrational and often predatory exploitation of natural resources, leads to the exhaustion of the latter, as well as to unfavorable change in the environment, difficult to correct in a number of cases. Marx emphasized: "...culture--if it develops spontaneously, rather than being consciously directed...--leaves a wasteland behind it..." ((2), page 45). Referring to Spanish planters in Cuba, who burned the forests covering the mountain slopes to obtain ash for fertilizer--enough for one generation of very lucrative coffee trees, Engels wrote: "...they cared not that torrential tropical rains would later wash away the henceforth defenseless upper soil layer, leaving nothing but denuded cliffs behind!" ((1), pages 498-499).

Economic development in socialist countries is based on national ownership of the resources of production. They enjoy incomparably greater possibilities for better conservation of the surrounding and natural environment. However, even in these countries the problem of environmental pollution and disturbance of the ecological balance between man, production, and nature deserves great attention.

Back in the first years of Soviet rule, V. I. Lenin defined the theoretical principles of the approach to environmental conservation. One of his works, "An Outline of a Plan of Scientific-Technical Work", contains the basic principles of socialist society's use of natural resources (3). The "Fundamental Law on Forests", "Protection of Fishing and Animal Grounds in the Arctic Ocean and White Sea", "Protection of Natural Monuments, Gardens, and Parks", and other decrees were adopted on Lenin's initiative. While serving as Chairman of the Council of Peoples Commissars he signed 94 decrees associated with nature conservation and use (41). Extensive nature conservation measures were also implemented in the first five-year plans and in the postwar years--for example forest belts were created to protect fields. But industrial development was more important than anything else. Environmental problems were once again addressed in the 1960's, but at a new level.

The issue of protecting the purity of the air and rivers, maintaining the forests and meadowlands, and constantly improving public health was first raised at the 23d CPSU Congress. In compliance with the decisions of the congress, much attention was devoted to the environment's rehabilitation in the Eighth Five-Year Plan.

The 24th CPSU Congress spelled out major tasks associated with reinforcing protection of the natural environment in the USSR, and it raised the responsibility of the ministries, departments, enterprises, institutions, and organizations for sensible use of natural resources. "Taking steps to accelerate scientific-technical progress," it was stated at the 24th CPSU Congress, "we must do everything to see that it proceeds in unity with a careful attitude toward natural resources, and that it would not be a source of dangerous pollution of the air and water, and the land's exhaustion" ((5), page 57).

A decision of the Fourth Session of the USSR Supreme Soviet and a decree of the USSR Supreme Soviet published in 1972, "On Measures for Further Improvement of Nature Conservation and Sensible Use of Natural Resources", were a further development of this problem. In that same year the CPSU Central Committee and the USSR Council of Ministers adopted the decree "On Reinforcement of Nature Conservation and Improvement of the Use of Natural Resources" (7). Moreover the Fundamental Principles of Land Legislation of the USSR and the Union Republics, the Fundamental Principles of Water Legislation of the USSR and the Union Republics, and the Fundamental Principles of USSR and Union Republic Legislation on Public Health were debated and adopted in recent years.

Efforts to improve the land, to prevent wind and water erosion of the soil, and to improve the use of water resources, the forests, and minerals are being conducted in the Soviet Union on a great scale. Valuable and rare animals have been placed under the state's protection. In accordance with this, beginning with 1975 the annual state plans for development of the USSR's national economy have included a new section, "Nature Conservation and Sensible Use of Natural Resources" (28). Assets supporting efforts to prevent pollution of the natural environment are being allocated on the basis of decisions of CPSU congresses and the government. Allocations for these purposes totaled 1.8 billion rubles in 1975 and 1.7 billion rubles in 1976 (29).

Special attention is being devoted to this problem in the 10th Five-Year Plan. L. I. Brezhnev's report to the 25th CPSU Congress notes: "...as the national economy develops, and as cities and industrial centers grow, increasingly larger assets will be needed to preserve the environment--just in the present five-year plan alone, 11 billion rubles are being earmarked for these purposes. And this sum will increase" ((6), page 43). A significant part of these allocations are for development of new wasteless production processes, integrated use of natural resources, and introduction of more-effective systems for developing and extracting minerals.

Environmental control agencies were created during the Ninth Five-Year Plan in order to coordinate the nature conservation measures and raise their effectiveness. Thus USSR Gosplan organized a nature conservation department. A corresponding department of nature utilization and environmental protection is operating within the USSR Council of Ministers State Committee for Science and Technology. The latter also has a scientific-technical council responsible for complex environmental problems and sensible use of natural resources. Similar departments have been created in the union and union republic ministries. State committees of nature conservation are functioning in the Ukrainian, Lithuanian, Azerbaijan, and a number of other union republics. Scientific councils on problems of the biosphere have been organized in the USSR Academy of Sciences and in the academies of sciences of the union republics. Measures to improve the quality of the environment are undergoing further perfection today.

Article 18 of the USSR Constitution makes guaranteeing reproduction of natural resources and improving man's surrounding environment a law.

Our country readily cooperates with other states in nature conservation and the use of natural resources. Joint efforts are being conducted in this area by

the CEMA countries, the USA, France, Finland, and others. These contacts are also necessary because the effectiveness of modern production, from the standpoint of the use of natural resources, remains extremely low, barely reaching 5-10 percent on the average. The remaining 90-95 percent of the natural resources are lost to man practically irreversibly ((13), page 37). Hence pollution of the environment by production wastes and consumption of resources are quickly growing, and if the evident trend persists, by 1990 the atmospheric discharges of pollutants will reach 43 billion tons for carbon monoxide, 355 million tons for sulfur dioxide, and 180 million tons for nitrogen compounds, the volume of waste water will total 15,270,000,000,000 tons, the total amount of solid wastes dumped will be about 15 billion tons, and so on (197). All of this attests to the importance of efforts dedicated to studying the economics of the environment.

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